Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] 1. A synthetic rectifier comprising
a MOSFET having a gate, a source and a drain,
a control circuit for turning the MOSFET off and on,
a current sense means for sensing the current from the source to the drain through the MOSFET,
a voltage sense means for sensing the voltage from the drain to the source across the MOSFET,
the control circuit being responsive to a decreasing current from the source to the drain through the MOSFET so as to turn off the MOSFET when the current from the source to the drain through the MOSFET decreases to zero, and
the control circuit being responsive to a decreasing voltage from the drain to the source across the MOSFET so as to turn on the MOSFET when the voltage from the drain to the source across the MOSFET decreases to zero.

[c2] 2. The synthetic rectifier of claim 1 wherein the current sense means comprises current sensing cells in the MOSFET.

[c3] 3. The synthetic rectifier of claim 1 wherein the current sense means comprises the measurement of voltage

from the source to the drain across the MOSFET while the MOSFET is turned on.

[c4] 4. The synthetic rectifier of claim 1 wherein the current sense means comprises the measurement of voltage across a portion of a current conducting conductor that is in series with the source and the drain of the MOSFET while the MOSFET is turned on.

[c5] 5. The synthetic rectifier of claim 1 wherein the control circuit maintains the voltage on the gate of the MOSFET at a voltage that is just sufficient to keep the MOSFET in saturation while the MOSFET is turned on so as to minimize the charge that must be removed from the gate of the MOSFET when the MOSFET is turned off, for faster switching.

[c6] 6. The synthetic rectifier of claim 1 wherein the MOSFET comprises a plurality of cells that are divided into a first group of cells and at least a second group of cells
the first group of cells collectively having a first gate connection,
the at least a second group of cells collectively having at least a second gate connection,
the control circuit having a first control output connected to the first gate connection to turn on and off the first group of cells

the control circuit further having at least a second output connected to the at least a second gate connection to turn on and off the at least a second group of cells so that the first group of cells and the at least a second group of cells can be turned off progressively as the current from the source to the drain through the MOSFET decreases to zero.

[c7] 7. The synthetic rectifier of claim 6 wherein the first group of cells is characterized by having a very fast switching time and the at least a second group of cells is characterized by having a very low resistance from the source to the drain through the MOSFET when the MOSFET is turned on.

[c8] 8. The synthetic rectifier of claim 6 wherein the first group of cells is characterized for linear operation after the at least a second group of cells has been turned off and until the current from the source to the drain through the MOSFET has decreased to zero.

[c9] 9. The synthetic rectifier of claim 8 wherein after the at least a second group of cells has been turned off the first output of the control circuit controls the voltage on the first gate connection so that the voltage from the source to the drain across the MOSFET is held constant as the current from the source to the drain through the MOSFET

decreases to zero.

[c10] 10. The synthetic rectifier of claim 1 further comprising a Schottky rectifier connected in parallel with the source and the drain of the MOSFET so that the control circuit can turn off the MOSFET before the current from the source to the drain through the MOSFET has decreased entirely to zero and the Schottky rectifier will then conduct current through the synthetic rectifier.

[c11] 11. The synthetic rectifier of claim 1 wherein the MOSFET comprises a plurality of cells and wherein the threshold voltage of individual cells of the plurality of cells varies with some of the plurality of cells having a higher threshold voltage, other cells of the plurality of cells having intermediate threshold voltages and still others of the plurality of cells having a lower threshold voltage so that as the control circuit reduces the voltage on the gate of the MOSFET to turn off the MOSFET, the plurality of cells turn off progressively, the some of the plurality of cells having the higher threshold voltage will turn off first, the other cells of the plurality of cells having the intermediate threshold voltages will turn off later and the still others of the plurality of cells having the lower threshold voltage will turn off last as the current from the source to the drain through the MOSFET decreases to zero.

[c12] 12. The synthetic rectifier of claim 1 wherein the control circuit senses a current threshold as the current from the source to the drain through the MOSFET decreases toward zero and initiates turn off of the MOSFET when the current from the source to the drain through the MOSFET crosses the current threshold,
the current threshold being set to the current that is the product of the rate of change of the current from the source to the drain through the MOSFET in amperes per second and the time that it takes to turn off the MOSFET in seconds.